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anti tank rocket

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A DIVISION OF
FLIGHTEX FABRICS INC.
CAMBRIDGE, MASS.

PRODUCT PROCESS Engineering

REPORT NO. 2-8-50G-1

MONTHLY PROGRESS REPORT

ENGINEERING PROGRAM FOR THE
DEVELOPMENT OF A LIGHTWEIGHT
ANTI-TANK ROCKET

FOR THE PERIOD

MONTH OF FEBRUARY 1958

CONTRACT NO. RD-142

[redacted]

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H E S S E - E A S T E R N D I V I S I O N

FLIGHTEX FABRICS, INC.

PROGRESS REPORT #6

ENGINEERING PROGRAM FOR THE DEVELOPMENT OF A LIGHTWEIGHT ANTI-TANK ROCKET

FEBRUARY 1958

CONTRACT NO. RD-142

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FLIGHTEX FABRICS, INC.
CAMBRIDGE, MASSACHUSETTS

Hesse-Eastern

WORK DONE DURING THE MONTH OF FEBRUARY 1958

REPORTING PERIOD 7 FEBRUARY TO 6 MARCH 1958

SYSTEM EVALUATION PROGRAM

The manufacturing of the first order of 100 components for E. M. No. 2 was 80 per cent completed during the period. Some difficulties in forming the stronger aluminum alloy for the motor bodies were experienced, and have caused delays in delivery of motor bodies. The fuze problem has received concentrated attention, and as far as can be determined from static tests, the problems have been overcome. Eight charges with the improved version of the liner were statically tested for penetration. The results, although not conclusive, show a marked improvement over the results of previous penetration tests. One redesigned launcher was assembled, and the relationship of front-sight, rear-sight target has been established. Five complete sets of launcher components are being manufactured. It is planned to finalize the design and place orders for the remaining number of launchers during March.

MOTOR DEVELOPMENT PROGRAM

E. M. No. 2 motors have been in the manufacturing process, and some difficulty was experienced in forming the nozzle section of the motor

body. The 20-24ST3 aluminum tubing, which is being used, turned out to be less ductile than anticipated. Several annealing and re-heat treating steps may have to be introduced in the manufacturing process. In view of the difficulties encountered, 10 motor bodies were ordered with an extra heavy wall. The object of this step is to obtain motor bodies which can be re-used in conducting fuze tests. The additional weight will not affect fuze testing. One of the main difficulties in forming the nozzle section was the opening up of the rear part of the motor body which has to be accomplished in order to provide the expansion cone as shown on Drawing No. B-8255 enclosed. This drawing also shows the heavy motor body, and as can be seen, the 2" diameter is carried all the way along the straight section of the motor body. It may be possible to facilitate manufacture if the expansion cone were somewhat reduced so that the end of the blank will not have to be opened up as much. If the test results warrant it, a shorter expansion cone will be used. However, if this should affect the impulse or flight characteristics of the round, one of two courses will be adopted:

1. The material will be changed.

2. A small ring will be staked on to the end of the motor body to provide the remaining section of the expansion cone.

WARHEAD DEVELOPMENT PROGRAM

Ten warheads were loaded with Comp B. In the course of the loading, the charge was accidentally pulled out of one of the heads (#9). The 9 remaining heads have been Xrayed. Examination of the Xray photographs

shows that in all except two cases an almost flawless charge was obtained. In the two remaining cases very small voids could be observed, in one case over the apex of the cone and in the other case near the sides of the liner. Careful measurements were taken of the volume displaced by the explosive charge, and the weight of the charge was carefully measured. Comparing the results of these measurements with the suggested density for Comp B, it was found that our densities were as follows:

Round No. 1	1.59	grams/cc
Round No. 2	1.57	"
Round No. 3	1.575	"
Round No. 4	1.58	"
Round No. 5	1.575	"
Round No. 6	1.57	"
Round No. 7	1.595	"
Round No. 8	1.58	"
Round No. 9	----	
Round No. 10	1.59	"

The suggested density for Comp B is 1.6 grams/cc.

STATIC PENETRATION TEST

A static penetration test was conducted on 3 March 1958. The listing of the results follows:

Round No. 1 - 8" penetration, stand-off 3 3/4
3/8" exit hole
Used ten 4" X 4" X 1" plate on bottom, three 10" X 10" X 1" on top
Charge weight = 466.3 gms., density = 1.59

armor or mild steel?

Round No. 2 - 7 1/2" penetration, stand-off 3 3/4
3/8" exit hole
Used ten 4" X 4" X 1" plate on bottom, three 10" X 10" X 1" on top
Charge weight = 460.3 gms., density = 1.57

Round No. 3 - 10" penetration, stand-off 3 3/4
Used all 10" X 10" X 1" mild steel plates
Bad double jet was noted on the first plate
Charge weight = 462.5 gms., density = 1.575

Round No. 4 - 9" penetration, stand-off 3 3/4
Used all 10" X 10" X 1" mild steel plates
Charge weight = 463.5 gms., density = 1.58
3/4" X 1 1/2" elliptical hole noted on the first plate

The following tests were performed on two 3" thick armor plates:

Round No. 5 - Penetration was less than 3"
Charge weight = 462.8 gms., density = 1.575

Round No. 6 - Reduced stand-off to 2 3/4"
6" penetration through armor plate
1/2" exit hole
Xray showed small cavities on side of liner
Charge weight = 460.1 gms., density = 1.57

Round No. 7 - 2 3/4" stand-off
6" penetration through armor plate
7/16" exit hole
Charge weight = 467.3 gms., density = 1.595

Round Nos. 1 and 2 were tested by placing four 12" X 12" steel plates on top of a stack of ten 4" X 4" plates. The same was done to No. 2. This procedure was stopped when it was observed that the jet on No. 2 was wandering too near the sides of the smaller plates. The procedure was then changed, and Round Nos. 3 and 4 were placed on top of fourteen 12" X 12" steel plates. Round Nos. 5, 6 and 7 were tested against a target consisting of two 3" pieces of armor with a gap of 1/4" between the plates. Round

No. 5 was tested using the same stand-off, namely 3 3/4". The penetration obtained was insufficient to go through both plates. The stand-off was then reduced to 2 3/4", and both Round Nos. 6 and 7 penetrated both plates, leaving an exit hole of approximately 1/2". This test gives an indication that the contractual requirements can be met without increasing the round diameter. It also appears that if the stand-off is reduced, sufficient penetration may be achieved without changing the cone configuration to the single angle liner. However, the results of this test are only tentative. Fifteen more charges will be statically tested in the second or third week of March before the decision on the liners can be reached.

Head bodies for 50 heat heads E. M. No. 2 were received during the month. They had to be rejected because the O. D. on all of the head bodies was over the tolerances. Twenty-five of these heads are being reworked to make them conform to the drawing. It was decided to use the remaining 25 for static penetration tests. They have been shipped to Eastern Tool Company for assembly with the copper cones.

FUZE DEVELOPMENT PROGRAM

INTRODUCTION

The malfunctions which occurred in previous tests were carefully examined and remedial action taken. Static tests with a number of different modifications to the double ball and shroud type of design were conducted. An answer was found to the problem. Some Fastax camera records give additnonal evidence that the solution which has been adopted is correct.

Fuze assemblies were readied for extensive dynamic testing.

ANALYSIS OF THE PROBLEM

The evaluation of various factors which might lead to inconsistent functioning of the fuze was continued along the lines stated in last month's report. No malfunctions had occurred when dropping the fuze assemblies from a height of 3 feet in order to set them back, but malfunctions did occur when the fuzes were dynamically tested. The rotor of the one fuze which could be examined after the dynamic test of 5 February had not armed, and there was evidence that the firing pin had come forward again after setting back, thus arresting the rotor in its motion. Some identical fuze assemblies were placed into the test fixture and dropped from a greater height. When the height was increased to 9 feet, similar malfunctions started to occur at a rate of about one malfunction for six or seven fuzes dropped.

Following the reasoning as outlined last month, it was felt that excessive overtravel was unlikely to be the reason for this. The only other alternative is bouncing of the triggering sleeve due to the very sudden deceleration of the triggering components when hitting the base plate of the fuze. An attempt was made to take Fastax pictures of this event. A plexiglass fuze housing was machined in order to be able to observe the action of the components inside of the fuze. (See Photograph No. 57) A number of launcher tubes were taped together and used as a simple drop fixture. In addition, a number of means were employed to eliminate the

bouncing of the triggering components.

The Fastax picture showed that the triggering sleeve moved forward before latching occurred. A double ball type of fuze was used, and the camera was not up to full speed when the event occurred so that the picture is not as clear as could be desired. By the time this motion picture was available, static tests had confirmed the thinking.

Static tests were conducted with the following modifications to the fuze:

1. O rings were placed behind the fuze and slightly compressed by giving the union on the test fixture first one-half then one-quarter turn. The object of this was to ease the deceleration to the whole fuze.

2. A lighter firing spring was used, and the fuzes not modified in any other way. The spring in question has more pre-load before the components set back, but a smaller load when all parts are fully back. Tests with this spring were conducted in order to find out whether the changed rate at which friction builds up has any affect on functioning.

3. A number of combinations of 1 and 2 were tried.

4. A thin (.004") neoprene gasket was placed over the base of the fuze. This was done in order to absorb some of the excess energy by compressing the neoprene.

5. The inertia element was backed by rubber. This was done to determine whether the expected increase in the bouncing action caused by the rubber would confirm the thinking on the malfunctions.

6. The back of the inertia element was covered with solder. This

was done to cause deformation in the solder, thus taking up the excess energy of the triggering components.

7. Increased overtravel. Increasing the overtravel by .020" to .040" would produce an overtravel condition far in excess of anything experienced so far. If the rate of failures remain about the same, this would definitely rule out overtravel as a cause for unreliable functioning.

8. The triggering sleeve was changed so that its rearward area of contact with the inertia element was the rear face of the sleeve instead of the face of the counterbore. This was done in order to observe whether the broader base thus obtained would improve the performance.

9. Three holes were drilled in the body of the inertia element in line with the longitudinal axis of the round. Roll pins were inserted into the holes. It was possible to change the amount which the pins protruded from the base of the inertia element. A certain amount of force was required to push the pins in flush with the base. An attempt was made to control and measure statically this force. It was set at approximately 1/2 to 1/8 pound, force required to push in all three pins.

10. A lead washer having a thickness of .060" was placed behind the base on the inertia element. This was done in order to absorbe some of the excess energy by deforming the lead. (See tables on following page)

EVALUATION OF STATIC TEST RESULTS

In evaluating the results of the static drop tests, it becomes evident that the only combination which produced no failures was the one

using the lead washer (No. 10). The conclusion reached was therefore that dynamic tests will have to be conducted in order to establish whether reliable fuze functioning will be obtained with this combination.

It is planned to conduct tests with 50 rounds against a steel plate to establish fuze functioning. Lead washers will be used with every fuze. Some of the fuzes will be the double ball design, and some will be the shroud design. The lead washers will be attached to the base of the inertia element by means of sealant.

Following the functioning tests, arming tests will be conducted to establish the arming distance of the fuze. As many fuzes as possible will be fired in the course of the planned accuracy tests.

LAUNCHER DEVELOPMENT PROGRAM

The launcher was redesigned in accordance with the decisions taken last month. The following changes were incorporated in the new design:

1. The bands around the launcher will be uniform.

2. All parts were redesigned to make them producible from the point of view of large scale production.

3. The safety handle was changed to make it suitable for manufacture using plastic as a material.

One complete launcher was manufactured to the new design and parts ordered for five more. In order to arrive at a practical, simple and inexpensive system of sights, the following procedure was adopted:

Bore sights were made to fit a launcher tube, and sighting the

tube in with the top of a target at a distance of 75 yards, the sights were lined up with the same point on the target. It turned out that the vertical distance measured from the top of the launcher between front and rear sight will be in the vicinity of 1/4". The sights are now in the process of being redesigned in accordance with these results. The starting point is a practical minimum height for the eye pupil of the person firing the round; he has to be able to comfortably shoulder the launcher and place his eye in line with the rear sight in such a way as to be able to line up the front sight without lifting his cheek off the launcher or having to squash his head against it. A conference was held at the Eastern Tool Company where methods of production were weighed against the design of each component of the launcher. This conference took place early in the month, and its results were used in the redesign.

Conferences were held with representatives of two companies who manufacture tubular rivets, and single-hand tools have been ordered to crimp all the rivets which will be used in the new launcher design. A sufficient quantity of sample rivets has been received to assemble the first few launchers.

Three steel launcher tubes with steel inner tubes have been ordered for launcher tests. It is anticipated that these tests will start in the third week of March. The tests will be run simultaneously with accuracy and fuze tests, and all launcher parts will be tested with the exception of the tube and inner tube. Five new launcher tubes made of stronger material have been promised for delivery early in March, and the remainder of the

order will be delivered later in the month. Immediately upon receipt of these tubes, tests will be conducted to establish whether they are strong enough. A hydro-static test fixture has been designed and placed in manufacture. This fixture will put a normal amount of hydraulic pressure to bear on the inside of the launcher. This pressure will be increased until the bursting point is reached. The results will be compared with the strength of aluminum tubing having a wall thickness of .040". A lesser pressure will be used as a routine hydro-static test on all launchers that are to be used for firing. A fixture is being designed which will make it possible to operate the trigger mechanism electrically by remote control with the use of a solenoid. This fixture will be used for all dynamic launcher and round tests. The enclosed photographs show the new launcher. It should be noted that this is the first hand-made model and that the trigger handle has been made from aluminum in order to speed up delivery of the parts.

FUTURE PROGRAM

1. Extensive fuze functioning and arming tests will be started in March and conducted through April. By the end of March or early April, it will be possible to place the final order for fuze components to finish the process.

2. Range and accuracy tests will be conducted in the same period, and the 100 motor bodies and corresponding round components which have been received or are in the process of coming in will be used for this task.

Records will be kept of velocities, weights and target hits. Dynamic penetration tests will be conducted by the middle of April.

3. Launcher tests will start in the middle of March when launcher components will be used to fire a test round. The final order for launcher components will be placed by the end of March or early in April.

4. After the above tasks have been accomplished, handling and safety tests will be conducted, and the final design will be obscured. Components of the final design will be tested as fast as they come in.

FUSE DROP TESTS

FUSE		RESULTS		COMMENTS	RUN #	
ORANGE	GREEN	O.K.	N.G.			
✓		✓	✓	"O" RING 1/2 TURN BEHIND FUSE	1	#1
	✓	✓		"O" RING 1/4 TURN BEHIND FUSE	2	
✓		✓			3	
	✓	✓			4	
✓		✓			5	
	✓	✓			6	
✓		✓			7	
	✓	✓			8	
✓		✓			9	
✓		✓			10	
✓		✓			11	
✓		✓			12	
✓		✓			13	
✓		✓			14	
✓			✓		15	
✓			✓		16	
	✓		✓		17	
	✓		✓		18	
	✓	✓			19	
	✓	✓			20	
✓		✓			21	
✓		✓			22	
✓		✓			23	
✓		✓			24	
✓		✓			25	
✓		✓			26	
✓		✓			27	
✓		✓			28	
✓			✓	LIGHT SPRING NO "O" RING	29	#2
	✓		✓		30	
	✓		✓		31	
	✓		✓		32	
✓			✓		33	
✓			✓		34	
✓			✓		35	
✓		✓			36	
✓		✓			37	

FUSE DROP TESTS

FUSE		RESULTS		COMMENTS	PON #
5 HPOUN	6 Ball	OK	N.G.		
✓		✓		No "O" RING LIGHT SPRING	38 #3
✓		✓			39
✓		✓			40
✓		✓			41
✓		✓			42
✓			✓	HEAVY SPRING NO "O" RING	43
	✓	✓			44
	✓	✓			45
	✓	✓			46
	✓	✓			47
✓		✓			48
✓		✓			49
✓		✓			50
✓		✓			51
✓		✓			52
✓		✓			53
✓		✓			54
✓		✓			55
✓		✓			56
	✓	✓		HEAVY SPRING .004 Neoprene	57 #4
	✓	✓			58
	✓	✓			59
	✓	✓			60
✓			✓		61
✓		✓			62
✓		✓			63
✓		✓			64
✓		✓			65
✓		✓			66
✓		✓			67
✓		✓			68
✓		✓			69
✓		✓			70
✓			✓	.026 RUBBER BACKING	71 #5
✓			✓	RESETS	72
✓			✓		73
✓			✓		74

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FUSE DELAY DROP TESTS

FUSE		RESULTS		COMMENTS	Run #	
Shroud	6Ball	OK	N.G.			
✓			✓	Replaced Cover with 1/8" Rubber	75	
	✓		✓	RESETS	76	
✓			✓		77	
	✓	✓		Sanded Back of Inertia Element	78	#6
	✓	✓		with Sander	79	
	✓	✓			80	
	✓	✓			81	
	✓		✓		82	
✓		✓		Increased overtravel .020	83	#7
✓		✓			84	
✓		✓			85	
✓		✓			86	
✓			✓		87	
✓				Changed point of contact on	88	#8
✓				Triggering sleeve.	89	
✓			✓		90	
✓					91	
✓					92	
✓			✓	Put 3 Rollpins behind	93	#9
✓			✓	Inertia Element	94	
✓			✓		95	
✓			✓		96	
✓			✓		97	
✓		✓		Used Lead Washer behind	98	#10
✓		✓		Inertia Element turned	99	
✓		✓		down Inertia Element	100	
✓		✓		.040 24 Weight drop	101	
✓		✓			102	
	✓	✓			103	
✓		✓			104	
	✓	✓			105	
✓		✓			106	
	✓	✓			107	
	✓	✓			108	
✓		✓			109	
✓		✓			110	
✓		✓			111	

FUSE ~~BENCH~~ DROP TEST SHEET #4

FUSE		RESULTS		COMMENTS	RUN #
SHROUD	GBall	OK	N.G.		
✓		✓		58 to 120 Same	112
	✓	✓			113
✓		✓			114
✓		✓			115
✓		✓			116
	✓	✓			117
	✓	✓			118
	✓	✓			119
	✓	✓			120
✓		✓		.040 off Inertia Element	121
✓		✓		No Lead	122
	✓		✓		123
	✓	✓			124
✓			✓		125

#7

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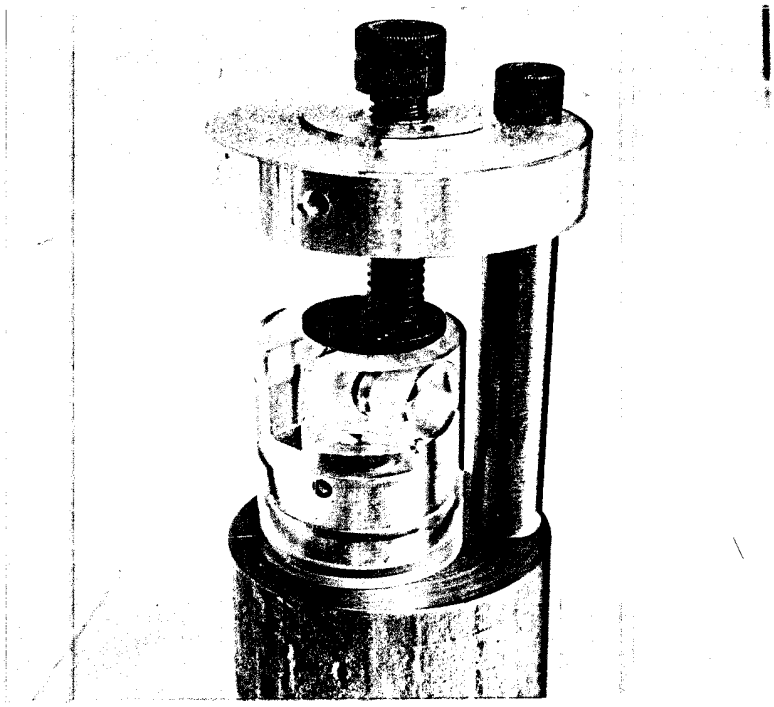
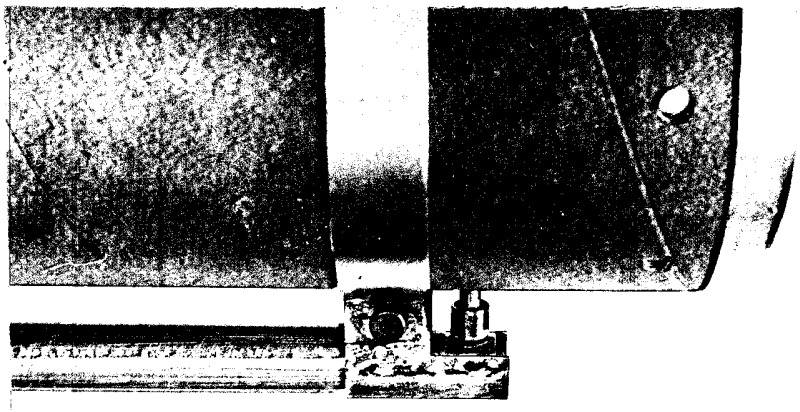
PHOTOGRAPHS

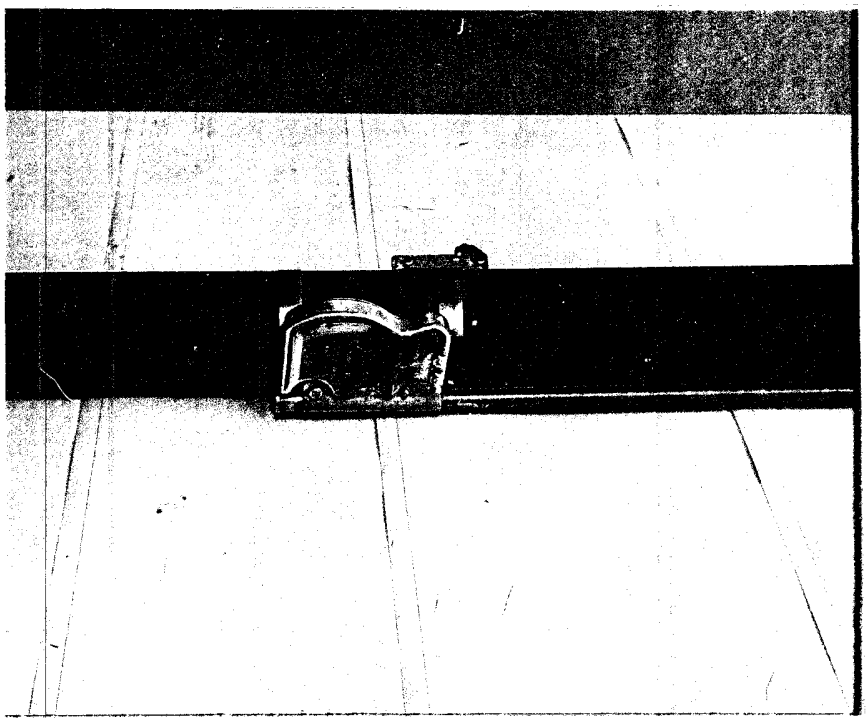


Photograph No. 57



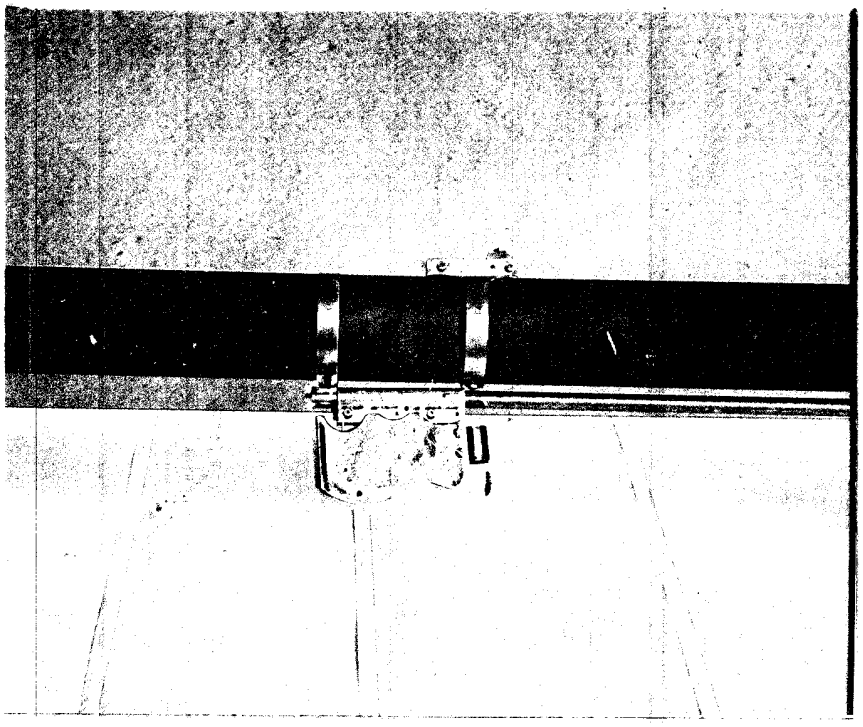
Photograph No. 58

Rear End of Redesigned Launcher



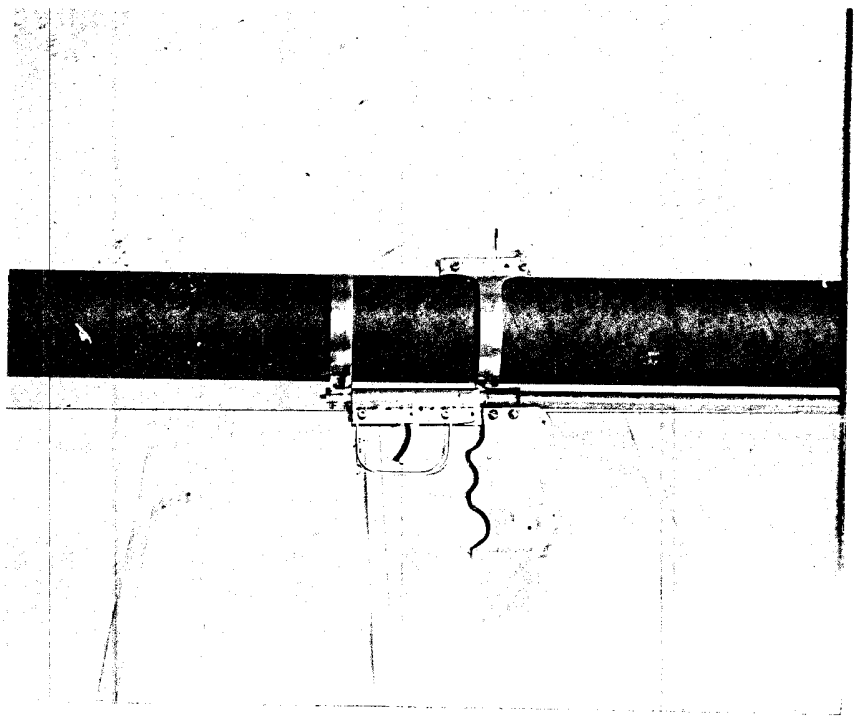
Photograph No. 59

Trigger Assembly in Storage Position



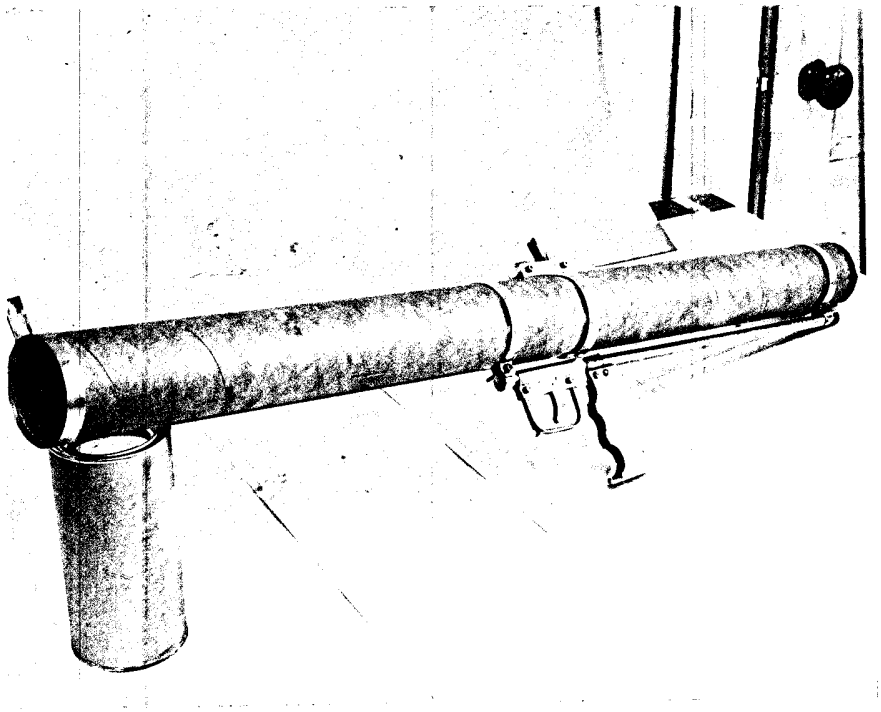
Photograph No. 60

Trigger Assembly Closed



Photograph No. 61

Trigger Assembly Open



Photograph No. 62

Redesigned Launcher Assembly